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AUTHOR Sunal, Dennis W.
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ABSTRACT

Presented is a Science Process Measure for teachers of science. The instrument consists of 18 items, a response sheet, and an answer key. No data regarding the instrument are provided. (CS)

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ED184824

User Information for Science Process Measure Form-B

Before you administer the Science Process Measure, place on your desk or on a large table the following items for the teachers to use as needed:

- equal-arm balance
- 30-cm ruler
- several graduated cylinders
- container of water
- paper clips, metal nuts, or gram masses

Task 15: Place on your desk a container, labeled "Task 15." The teachers are to estimate its diameter, height, and volume. An unmarked cylindrical object such as a tin can is satisfactory. The object should be at least one decimeter high.

Task 18: Each teacher should have an object whose length or diameter can be easily measured with a 30 cm ruler. The object should be hollow so that it can be filled with water and the volume of water measured to determine the volume of the object. Paper cups, tin cans, plastic vials, and drinking glasses are satisfactory.

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SE 030 313

SCIENCE PROCESS MEASURE -- FORM B*

Please complete each of the tasks to the best of your ability in the time allowed. Perform the tasks for which you feel most competent first; then return to those tasks you skipped.

Place all responses on the response sheet. You will need objects for tasks 15 and 18. Please do not write in this booklet.

1. On the response sheet are several statements. Indicate with an "X" in the appropriate box which statements are inferences and which are hypotheses.

2. Here is a table of data collected during an investigation to find out how many feet it took for a car to stop after the brakes were applied when the car was travelling at different speeds.

Speed, km/hr	Braking Distance, meters
20	3.5
40	10.0
50	15.0
60	21.5
70	30
80	40.5

Construct a point graph of these data on your response sheet. Be certain to label the axes.

3. Task 2 described an investigation of the braking distance of a car. Name the manipulated variable and the responding variable for this experiment.

4. On the response sheet, check the patterns that are symmetrical with respect to a line. If none is symmetrical with respect to a line, check "No pattern is symmetrical with respect to a line." Suppose you could cut out the figures. Describe how you would distinguish which patterns are symmetrical and which are not symmetrical.

A modified version of Science Process Measure for Teachers (AAAS) 1969
Dennis W. Sunal, West Virginia University.

5. Below is a table of data about eight children in a class. Construct a multistage classification that could be used to identify each of the eight children.

Name	Birthday		Height		Siblings	
	Before June 30	After June 30	> 12 dm	< 12 dm	0-3	> 3
John	✓		✓			✓
Karl		✓	✓			✓
Larry	✓			✓	✓	
Mark		✓		✓	✓	
Neal	✓		✓		✓	
Oscar	✓			✓		✓
Paul		✓		✓		✓
Quentin		✓	✓		✓	

6. A teacher showed his class the following containers:

	Contents	Observation
A	Open container of powdered gelatin	no mold
B	Open container of gelatin and water	much mold
C	Open container of powdered agar	no mold
D	Open container of agar and water	much mold

The class made the following inferences based on these observations:

Inference A. Mold will not grow on dry substances.
Inference B. Air is necessary for mold to grow.

Which observations support each of these inferences?

7. State a rule for determining the time rate of change of a property or position of an object.

8. A kickball is 0.5 meter around (circumference). From the pitcher's mound to homeplate is ten meters. When a child rolls the ball on the ground, it takes two seconds for the ball to roll from the pitcher's mound to homeplate.

What is the average speed of the ball in:

A. Meters per second?
B. Number of revolutions per second?

9. On the response sheet is a graph. Place an "X" over a point that represents an observation. Draw an arrow to identify any point on the curve that represents a prediction.

10. On the basis of the information in the graph shown for Task 9, write your predictions of the number of milliliters of gas that would be given off each minute if the temperature of the culture of yeast were set at:

    A. 46° C
    B. 90° C

11. Two jars of the same size and shape were half-filled with water. Four ice cubes were added to one jar, and eight to the other. The experimenter observed that the four ice cubes took 20 minutes to melt and the eight ice cubes took 60 minutes. Based upon this information, three children predicted the melting time for six ice cubes in a jar half-filled with water:

    Jim predicted 45 minutes

    John predicted 40 minutes

    George predicted less than 40 minutes, but more than 20 minutes.

    Order these three predictions from most to least reliable and describe the basis for your decision.

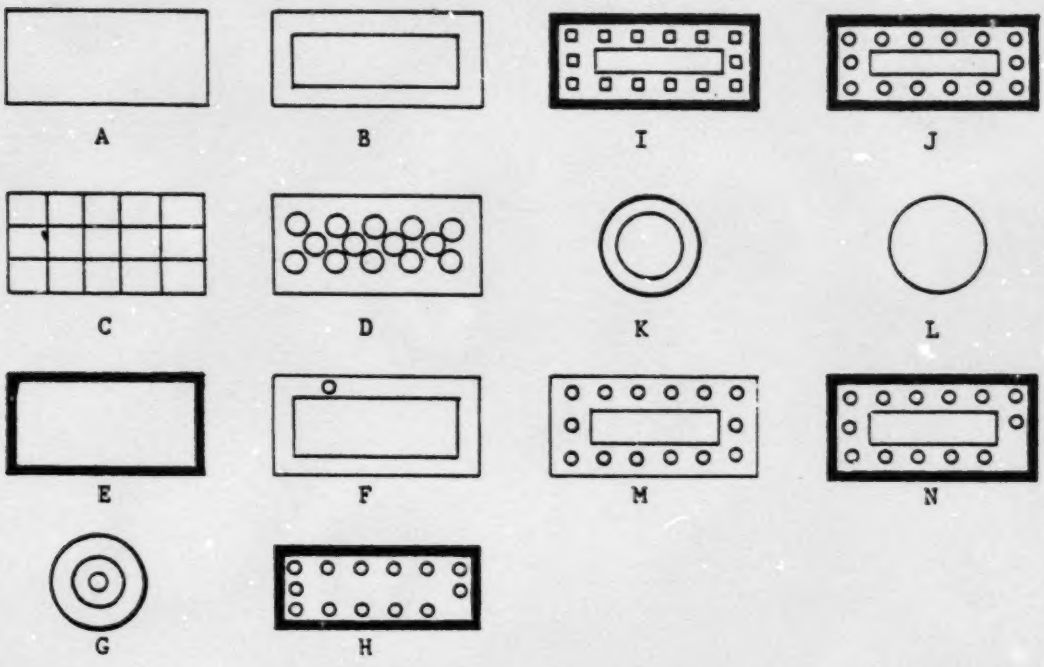
12. The following table gives some data from a large group of people about how often color blindness occurs in the children of parents who are or are not colorblind:

	Sons	Daughters
A. When both father and mother are color-blind, color blindness in the children occurs as follows:	all	all
B. When mother is color-blind and father is not color-blind, color blindness in the children is as follows:	all	none
C. When father is color-blind and mother is not not color-blind, color blindness in the children is as follows:	0.25	0.25
D. When neither father nor mother is color-blind, color blindness in the children is as follows:	0.25	none

Indicate whether the data in each row support or do not support the following statement about colorblindness:

If one or both parents are colorblind, at least half of the children will be colorblind.

13. Examine carefully the pictures of the items shown in the following figure. Write a description of item "N" so that another person could read your description and pick out item "N" from among all of them.



14. Different children made these statements about an object inside a sack. They had felt and smelled the object but had not looked at it.

A. It is a tube of glue.

B. It can be bent.

C. It smells like peppermint candy.

D. It feels like a tube that is not full.

E. It might be a tube of toothpaste.

F. It is a plastic tube.

Indicate whether each statement is an observation, an inference, or neither.

15. At the front desk is an object labeled "Task 15." Without using any measuring instruments, you are to record the following estimations for this object on the response sheet:

A. Diameter of the object in millimeters.

B. Height of the object in decimeters.

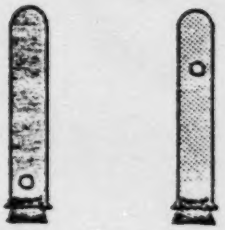
C. Volume of water that the object could hold when filled full, in liters.

16. A child constructed the inference that a potato cut in the shape of a cube will lose water faster than a potato cut in the shape of a cylinder.

    Describe a test of this inference.

    List the variables in your test.

17. Two stoppered tubes containing different liquids were turned upside down at the same time. An air bubble in each then began to rise to the top, as shown in this figure:



    From this observation a child made this hypothesis: Air bubbles rise faster in some kinds of liquids than in others.

    While the child was testing his idea, he observed that air bubbles rise faster in liquids A and B when they are warm than when they are cold. On the basis of this new information, revise the hypothesis originally made by the child.

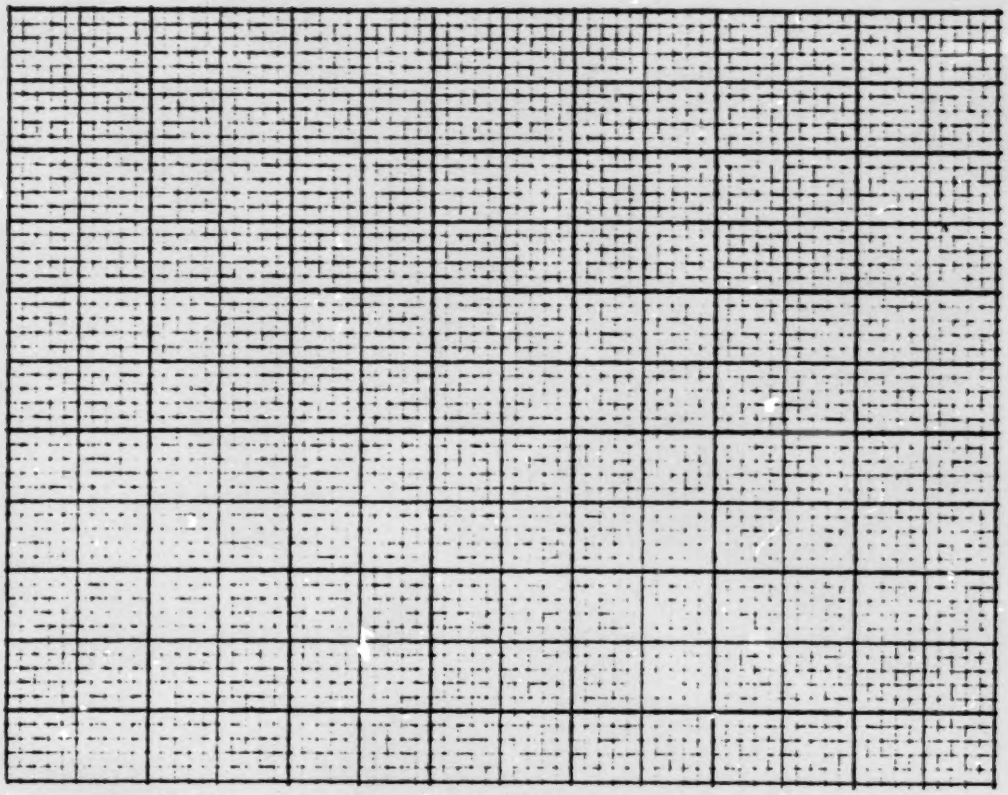
18. The instructor will name an object for use in this task. Measure the length and volume of this object. You may use any of the materials at the front desk to help you make these measurements. Record the measurements on the response sheet.

FORM B RESPONSE SHEETS

1. Check the appropriate boxes:

Inference	Hypothesis	
☐	☐	The tires on this Stingray bicycle wear out fast because the wheels are small.
☐	☐	Small tires wear out faster than large tires.
☐	☐	A tree that is green in the winter has needles.
☐	☐	This tree has leaves instead of needles so it will not be green next winter.

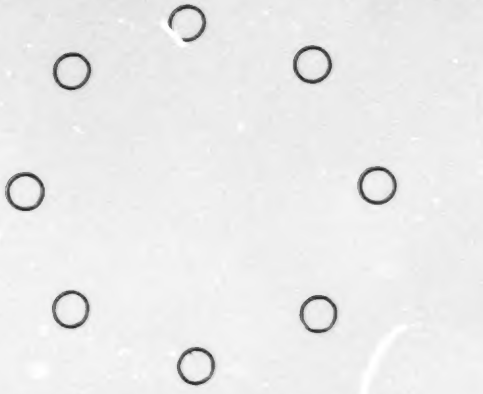
2.



3. The manipulated variable is _____

The responding variable is _____

4.



_____Pattern A

_____Pattern B

_____Pattern C

_____No pattern is symmetrical with respect to a line.

Symmetrical and nonsymmetrical patterns are distinguished by_____

_____

_____

_____

5.

6. Observations that support Inference A: _____

_____

_____

Observations that support Inference B: _____

_____

_____

7. The rule for determining the time rate of change of a property or position of an object is: _____

_____

_____

_____

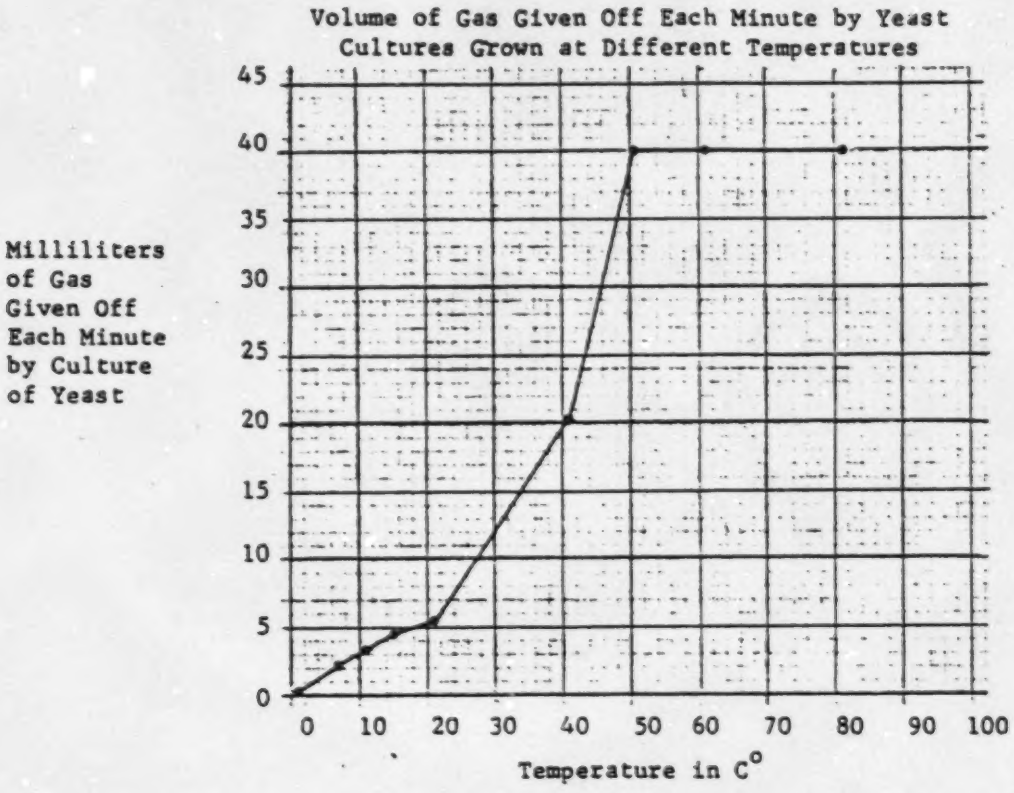
8. A. _____

_____

B. _____

_____

9.



10. A. _____

B. _____

11. _____, _____, _____
Most reliable Least reliable

Basis for the above ordered sequence:

_____

_____

_____

_____

12. Check the appropriate boxes:

Support the Statement	Do Not Support the Statement	
☐	☐	Data in Row A
☐	☐	Data in Row B
☐	☐	Data in Row C
☐	☐	Data in Row C

13. Description of Item N_____

_____

_____

_____

_____

_____

14. A. Observation Inference Neither

B. Observation Inference Neither

C. Observation Inference Neither

D. Observation Inference Neither

E. Observation Inference Neither

F. Observation Inference Neither

15. A. Diameter in millimeters_____

B. Height in decimeters_____

C. Volume of water in liters_____

16. Test of the inference:_____

_____

_____

_____

_____

_____

_____

_____

Manipulated variable is_____

_____

Responding variable is_____

_____

Variables held constant are_____

_____

17. Revised hypothesis:_____

_____

_____

_____

18. The measurements are:

Length_____

Volume_____

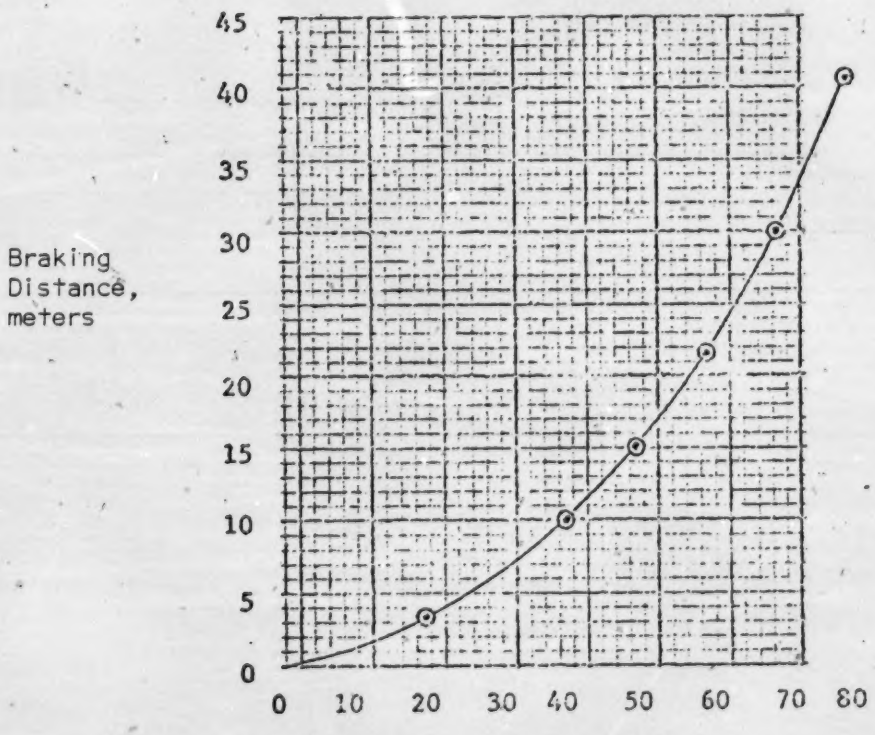
SCIENCE PROCESS MEASURE -- FORM B
KEY TO RESPONSE SHEET

1. All statements should be correctly identified.

Inference	Hypothesis	
☒	☐	The tires on this Stingray bicycle wear out fast because the wheels are small.
☐	☒	Small tires wear out faster than large tires.
☐	☒	A tree that is green in the winter has needles.
☒	☐	This tree has leaves instead of needles so it will not be green next winter.

2. All of these criteria must be met for an acceptable response:

   1. Labeling of both axes.
   2. (0, 0) at the intersection of the axes.
   3. Equal intervals for each unit along an axis.
   4. Approximately correct location of five of the six points.

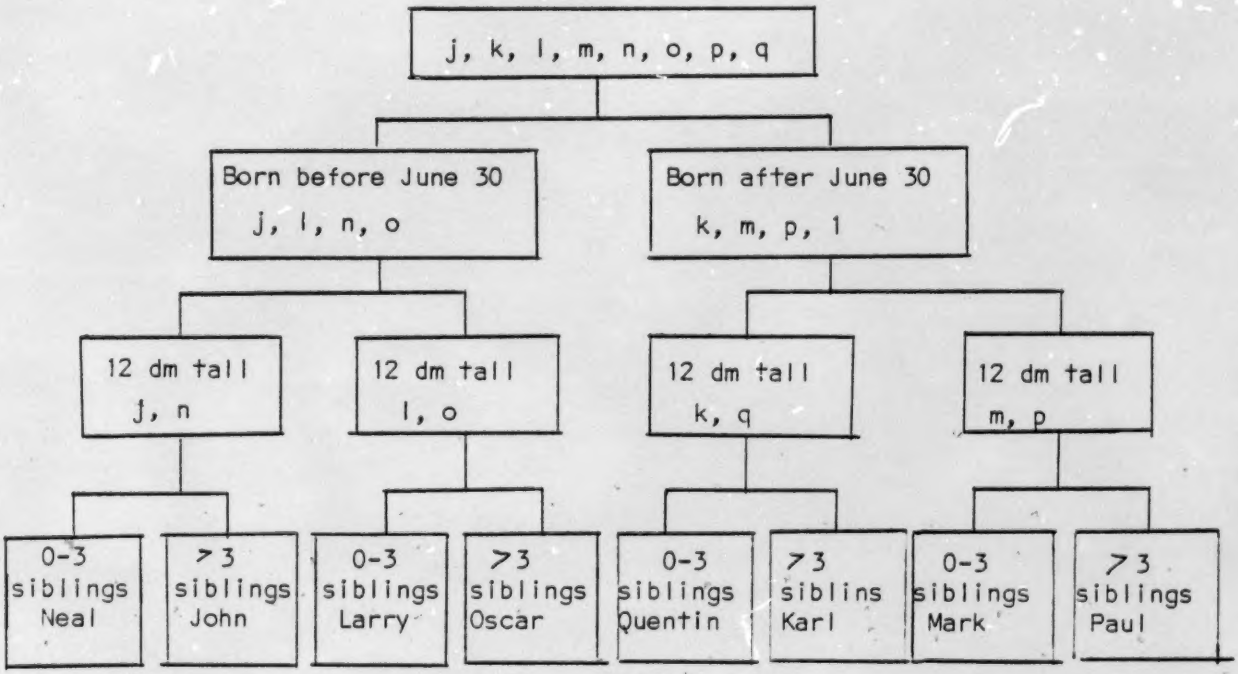


3. The manipulated variable is the speed. The responding variable is the braking distance.

   Both variables must be correctly named for an acceptable response.

4. For an acceptable response, only Patterns A and B should be checked and the description should include a statement about folding the cut out figures to see whether they have matching halves.

5. For an acceptable response the classification scheme should permit the identification of all eight children. For example:



6. Observations A and C support Inference A.

   Observations B and D support Inference B.

7. The time rate of change of a property or position of an object is given by the amount of change divided by the time it took for the change to occur.

8. A. 5m/second

   B. 10 revolutions/second

9. Both of the following are required for an acceptable response:

   1. An "X" over one of the solid black circles.

   2. An arrow pointing at any point between the solid black circles.

10. Both of the following are required for an acceptable response:

    A. Approximately 33 ml/minute.

    B. 40 ml/minute.

11. An acceptable response consists of a statement of the reasons for the sequence that is consistant with the sequence shown.

12.

Support the Statement	Do Not Support the Statement	
☒	☐	Data in Row A
☒	☐	Data in Row B
☐	☒	Data in Row C
☐	☒	Data in Row D

13. The description should permit correct identification of item N for an acceptable response.

14. A. Inference

    B. Observation

    C. Observation

    D. Observation

    E. Inference

    F. Inference

15. All three estimations should be within the range of actual measurement ± 25%. For example, if the actual volume is 2.4 liters, any estimation from 1.8 to 3.0 liters would be acceptable.

16. An acceptable response consists of correctly naming the manipulated and responding variables and at least two variables held constant, such as:

    Manipulated variable - shape of potato

    Responding variable - rate of loss of moisture

    Variables held constant - type of potato
    temperature
    size of pieces
    whether or not a piece has skin on it

17. Any hypothesis about air bubbles rising in liquids of different temperatures is acceptable.

18. The two measurements should be approximately named. Both the numeral and unit should be specified for each measurement for an acceptable response.